DOCUMENT RESUME

ED 440 636 IR 020 282

AUTHOR Jones, Beau Fly
TITLE Learning with Technology: Integrating New Technologies into Classroom Instruction.
INSTITUTION North Central Regional Educational Lab., Oak Brook, IL.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE 1998-00-00
NOTE 14p.; For "Learning with Technology" (Facilitator's Guide and Participant's Manual), see ED 425 710. For online course: http://www.ncrtec.org/pd/lwt/lwt.htm.
AVAILABLE FROM North Central Regional Educational Laboratory, 1900 Spring Rd, Suite 300, Oak Brook, IL 60523-1480. Tel: 800-356-2735, (Toll Free); Web site: http://www.ncrel.org.
PUB TYPE Reports - Descriptive (141)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Computer Assisted Instruction; *Computer Literacy; Computer Uses in Education; *Educational Technology; Elementary Secondary Education; *Faculty Development; Teacher Workshops; Training
IDENTIFIERS Student Engagement; Teacher Engagement; *Technology Based Instruction; *Technology Integration

ABSTRACT

After providing a snapshot of the state of technology and technology use in America's schools, this paper notes that a major obstacle to technology integration in schools is the lack of teacher training. The paper then goes on to describe "Learning with Technology," a sustained, six-session professional development experience with a goal of helping teachers develop effective, technology-supported instructional activities that enhance student learning and achievement. The concept and research basis of engaged learning is described, followed by an explanation of the "Learning with Technology" course design, resources, and guiding questions. The instructional phases of "Learning with Technology" course are outlined, and a synopsis is given that lists what participants will practice and achieve in each of the six, two-hour sessions. The evaluation component is then discussed, and the implementation status and early results of "Learning with Technology" are described. The paper concludes with a look toward the future. (Contains 47 references.) (AEF)

Learning With Technology: Integrating New Technologies into Classroom Instruction

By Beau Fly Jones

LEARNING WITH TECHNOLOGY

There's a dynamic shift occurring in this country as we move from traditional definitions of learning to models of engaged learning that involve more student interaction, more collaboration among teachers and students, more involvement of teachers as facilitators-and engaged learning.

Beau Fly Jones

Integrating New Technologies Into Classroom Instruction

NCREL NCREC

A Snapshot of Technology in America's Schools

The good news for students in the United States is that they are fast becoming members of a high-technology educational community. There is no longer any argument that technology—particularly high-end technology characterized by interactivity—is a powerful and necessary resource for across-the-board educational improvement (Illinois State Board of Education, 1993). Moreover, technology has become an important, well-funded centerpiece for America's educational reform initiatives and a top priority of the President's education agenda (National Telecommunications and Information Administration, 1997). State education agencies, school districts, and schools all are accelerating their efforts to wire-up and plug students into the latest advances in technology. As a result, estimates show there are now more than 5.8 million computers in America's schools earmarked for instructional purposes. In addition, 85 percent of all public schools have the capacity to use CD-ROMs and 75 percent have access to either local or wide area networks.

The bad news for public school students is that this high-technology community may not be as large or as comprehensive as it should be to keep pace with our country's growing technology needs and demands. The U.S. General Accounting Office reports that our nation's schools are "not even close to meeting their basic technological needs" (North Central Regional Educational Laboratory, 1996). For instance, only 50 percent of our public schools have Internet access, and this number shrinks to only 31 percent for schools that serve "poor" students. Worse still, only 9 percent of America's public schools have Internet access at the classroom level (Heaviside, Farris, Malitz, & Carpenter, 1996). According to the U.S. Department of Education *(Getting America's Students Ready,* 1995), 96 percent of our public schools do not have enough computers available to allow their students regular use (one computer for every five students).

Thus it should come as little surprise that in 1992, 70 percent of students polled for the National Assessment of Educational Progress (NAEP) reported "never or hardly ever using computers." This figure rose to about 45 percent in 1993, but these still are staggering statistics given our national push for educational technology (Greenberg, 1995).

A Snapshot of Technology Use in America's Schools

Moving beyond the statistics, if we examine how most schools use the technology they have, we find that few use it for meaningful, engaged learning. There are exceptions of course (for excellent examples, see Southwest Educational Development Laboratory, n.d.), but for the most part students use technology in a largely passive way consistent with transfer, not authentic-learning approaches. They use it, for instance, to access information for reports (often from online or CD-ROM encyclopedias or libraries), to view science experiments or scientific phenomena, for basic skills drill and practice, to do computations, to create computer-based reports and presentations, to watch lectures from a distance, and so forth. There is little true interactivity and virtually no attempt to incorporate user contributions. Furthermore, student technology use in most schools is independent, one way, and task based rather than problem based (Jones, Valdez, Nowakowski, & Rasmussen, 1995). To put it another way, in our schools we tend to use technology at what Moore (1995) characterizes as a minimal level—as a teaching *aid* appended to what we have always done, rather than as a teaching *tool* integrated meaningfully into instruction (Illinois State Board of Education, 1993).

It is important to stress that using technology as an aid in the ways noted is not without value. It is, however, in our opinion a very basic use. It does not capitalize on the potential technology has to produce dramatic, positive changes in teaching, learning, and thus student achievement (Glennen & Melmed, 1996; Illinois State Board of Education, 1993; Owston, 1997). The Illinois State Board of Education (1993) puts it succinctly:

> *Technology can expand learning resources and learning opportunities, respond to differences among students, empower students and free teachers, promote the integration of knowledge across disciplines, and break down the traditional definitions of where, when, and how teaching and learning take place. The key word here is can.*

They go on to note that when technology is used only to enrich or if students and teachers do not have meaningful access to technology, there will be few demonstrable effects on teaching or learning.

Support for this opinion comes from the Benton Foundation (Conte, 1995) which found that when the use of technology is imbedded in curriculum and instruction, it "multiplies the resources available to schools and teachers, greatly increasing opportunities for both teaching and learning."

What's the Problem?

First, we can say with a fairly high level of confidence that what used to be significant barriers to technology use in schools' access to equipment and access to appropriate connections are rapidly diminishing (McKinsey & Company, n.d.). And although funding challenges still exist, the once-severe lack of funds no longer seems as large an obstacle. Literally billions of dollars from state, federal, and private sector sources are being funneled to support and subsidize educational technology (Benton Foundation, 1995; Market Data Retrieval, n.d.; Telecommunications Act of 1996).

Bluntly put, a major obstacle to integrating high-end technology as a tool for engaged learning in the classroom is teacher training. As the Office of Technology Assessment of the Congress of the United States (1995, p. 2) says, "Helping teachers use technology effectively may be the most important step to assuring that current and future investments in technology are realized." Moreover, this statement represents the viewpoint of a wide range of experts and expert practitioners (McKinsey & Co., n.d.; Kaye, Jacobs, Aschenbacher, & Judd, 1996; Callister & Dunne, 1992; Schlosser & Anderson, 1993; Trotter, 1997; Levin & Thurston, 1996; Office of Technology Assessment, 1995), although there are some who disagree (Cuban, 1996).

For the most part, however, this kind of professional development is just not happening. For example, in a 1993 survey, Market Data Retrieval found that only 15 percent of school district technology expenditures is used for professional development. The survey results also revealed that professional development focuses too much on the mechanics of operating machines with practically no training in how to integrate technology into classroom instruction or use it as a pedagogical tool (Office of Technology Assessment, 1995). Only 17 percent of surveyed Ohio high school principals said their professional development for teachers included an emphasis on technology "as a tool for student inquiry" versus 43 percent who said it centered on "operating the technology" (Hawkes, Quinn, Bell, & Knott, 1996).

What's a Solution?

The Office of Technology Assessment report *Teachers and Technology: Making the Connection* (1995, p. 161) concludes:

> *Supporting teachers in their efforts to integrate technology throughout their teaching is central if technology is to become a truly effective educational resource, yet true integration is a difficult, time-consuming, and resource intensive endeavor.*

It is an endeavor worth undertaking, however, as most teachers agree that new technologies provide powerful tools for learning, communicating, and collaborating. But with the explosion of technology applications now available and the speed at which they are introduced in schools, teachers are rapidly becoming overwhelmed. Even if the average teacher is not confused by the array of technology options (computers, CD-ROMs, the Internet, e-mail, bulletin boards, chat lines, virtual reality, and so forth) he or she is not well equipped to integrate any of these new technologies into classroom instruction in meaningful ways. The typical solution is to fall back on the tried and true, which results in passive use by students.

Both research and experience show that simply acquiring high-performance technology tools will not ensure a more authentic instructional environment, more engaged learning, or greater student achievement. However,

we have seen that technology, when used effectively, can play a significant role in enhancing authentic instruction, engaged learning, and student achievement. Recent research on teaching and learning builds a strong case for using instructional models that promote engaged, meaningful learning and collaboration that is rooted in challenging and real-life tasks. It further suggests that technology can serve as a tool to support, enhance, and extend instruction in ways that are not possible without it (Jones, Valdez, Nowakowski, & Rasmussen, 1995).

As educators plan for the use of technology in their schools and districts, it is critical that they begin with a focus on learning goals. Only when we consider how to use the findings of research and best practice to design effective instruction can we make sound decisions about technology use. It is a strong commitment to this fundamental principle that prompted the development of a course called *Learning With Technology.*

Learning With Technology is a six-session course of study developed by the North Central Regional Educational Laboratory (NCREL) and the North Central Regional Technology in Education Consortium (NCRTEC). The course is designed to help teachers make the task of integrating technologies easier.

What *Learning With Technology* Is and Is Not

Learning With Technology IS NOT an introduction to or training on using the Internet. It also IS NOT an introduction to the fundamentals of technology. Likewise, it IS NOT intended to provide teachers with technical skills for operating and trouble-shooting computers or other forms of hardware. Finally, it IS NOT designed specifically to help teachers evaluate educational software.

Learning With Technology IS a sustained, six-session professional development experience for those who can and want to spend approximately twelve hours working with colleagues to understand engaged learning and how it can be supported and enhanced by technology. There are certain "prerequisites" for enrollment in the course. First, participants must make the personal commitment to devote more than twelve hours (counting presession assignments) to the course and to participate actively. Second, where necessary, the school must make a commitment to release the participant for at least those twelve hours. Finally, participants must be in a school where they and their students have access to the Internet. Participants also must know how to use the Internet as well as some basic software applications, such as word processing, spreadsheets, or databases.

We need to note that because of the nature of the video and print scenarios and examples included in the course, *Learning With Technology* is currently only for those who teach grades four through nine. Eventually, we hope to expand the course to apply to the primary level as well as the later high school grades.

The Concept of Engaged Learning

The goal of *Learning With Technology* is to help teachers develop effective, technology-supported instructional activities that enhance student learning and achievement. Two basic strategies help us achieve this goal: individual and group analysis of instructional examples and individual and group design of instructional activities.

Central to the course and its goal is a vision of learning we call "engaged learning" We define it as follows:

> *Highly engaged learners take an active role in meaningful tasks and activities. They assume increasing responsibility for their own learning and demonstrate their understanding. They explore a variety of resources and strive for deep understanding through experiences that directly apply to their lives, promote curiosity and inquiry, and stimulate new interests.*

With this definition of engaged learning underpinning the course goal and serving as its foundation, *Learning With Technology* uses structured activities and processes to lead teachers to focus on instructional models that promote engaged learning. The course also calls on them to distinguish between more- and less-effective uses of technology as they support these models.

The Research Basis of Engaged Learning

The notion of engaged learning can be traced across many strands of research where there is increasing consensus on the key variables of learning and instruction. These include theories and concepts such as:

- Anchored instruction (Bransford, Vye, Knizer, & Risko, 1990)
- Metacognition (Brown, 1978)
- Cognitive apprenticeship (Collins, Brown, & Holum, 1991)
- Multiple intelligence (Gardner, 1991)
- Reciprocal thinking (Palinscar & Brown, 1984)
- Communities of practice (Roupp, 1993)
- Thinking curriculum (Resnick & Klopfer, 1989)
- Cognitive flexibility (Spiro & Jehng, 1990)
- Distributed intelligence and knowledge-building communities (Pea, 1993).

From these concepts and theories, Jones et al. (1994) identified eight key variables of instruction that provide a rich profile of engaged learning and the conditions of the learning environment necessary to yield engaged learning. These variable are (1) the vision of learning, (2) tasks for engaged learning, (3) assessment of engaged learning, (4) instructional models and strategies for engaged learning, (5) learning context for engaged learning, (6) grouping for engaged learning, (7) teacher roles for engaged learning, and (8) student roles for engaged learning.

Course Design, Resources, and Guiding Questions

Because the concept is so fundamental, *Learning With Technology* begins by exploring engaged learning. Two questions are central to all course activities:

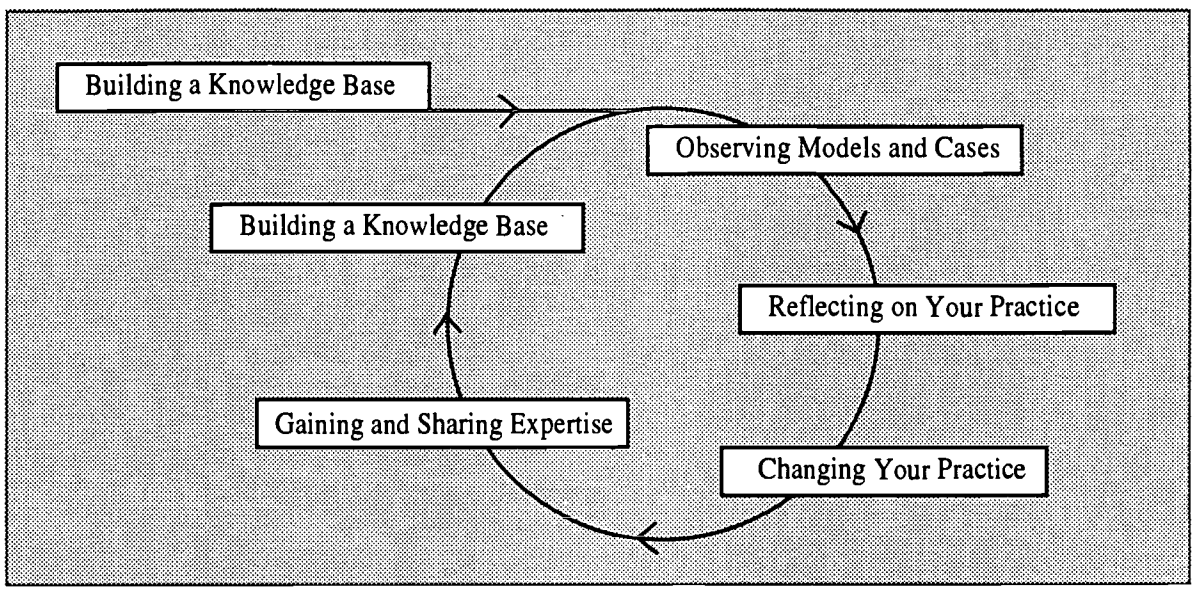
- In what ways does this lesson promote engaged and meaningful learning?
- How does technology enhance and extend this lesson in ways that would not be possible without it?

Print, video, and other electronic resources help course participants address these questions. Of particular important among these resources are the *Learning With Technology* "Planning Framework"—which is used to examine, design, and refine technology-supported lessons—and a series of video, print, and online instructional "scenarios"—instructional examples intended to stimulate discussion and analysis. As is the case with the course as a whole, the resources reflect research about teaching, learning, and technology. Yet, significantly, the course relies greatly on craft knowledge and the wisdom of practitioners—both these enrolled in the course and those appearing in the print, video, and online examples.

During the cours, participants use the Planning Framework with the online, video, and print scenarios as well as with sample lessons, their own lessons, and even lessons from other teachers in the course or in their school. Often participants are encouraged to look for these examples on the Internet.

A Professional Development Approach

First and foremost, *Learning with Technology* is a professional development experience. Thus, as the participants work through the six-session course, they follow a particular model of professional development formulated by NCREL.



Reflective of current research about adult learning and staff development, this model is based on an extremely important principle that sets adult learners apart from young learners: the former have a longer, usually richer, lifetime of experiences to draw on. Because of this experience, they approach learning as a process of change (Brundage & Mackeracher, 1980) that they can manage themselves (Lieberman, 1995) and where they fully expect to construct their own knowledge (Brooks & Brooks, 1993). Adult learners enter a learning situation with a different set of attitudes and consequently need different approaches to instruction (Roy, 1987).

Acknowledging the difference between young and adult learners, yet recognizing that much of the latest research about children's learning applies to adults as well, NCREL has structured the *Learning with Technology* course around five adult-oriented instructional phases that are cyclical and serve as scaffolds for each other:

Build a Knowledge Base: participants acquire new information and skills related to instruction (Loucks-Horsley & Stiegelbauer, 1991; Borko & Putnam, 1995; Feiman & Floden, 1980)

Observe Models and Cases: participants study and analyze examples of instruction in order to develop practical understanding (Oja, 1991; Eraut, 1995; Guskey, 1997)

Reflect on Practice: participants analyze themselves while turning their theoretical and practical knowledge into plans for alternative instructional practices (Darling-Hammond & McLaughlin, 1995; Sparks & Hirsch, 1997; Schubert & Ayers, 1992)

Change Practice: participants experiment with new or alternative instructional practices in real-life situations (Sparks & Hirsch, 1997; Schubert & Ayers, 1992; Holly, 1991; Guskey, 1997)

Gain and Share Expertise: participants discuss and analyze their instructional experimentation and exchange practical wisdom with colleagues (Ayers, 1993; Guskey, 1995; Zeichner, 1982)

Course Scope and Sequence

In its six, 2-hour sessions, *Learning With Technology* offers participants both breadth and depth of information and skill development. Each session is tailored to bring them closer not only to a fuller understanding of engaged learning enhanced by technology but also to the practical application of that understanding. As they progress through the course and the five dimensions of professional development and growth noted earlier, course participants will:

- Explore the concept of engaged learning and the role of technology.
- Use a planning framework to analyze and design technology-supported lessons that engage students.
- Analyze video, print, and online instructional examples.
- Explore the instructional resources available on the Internet and the World Wide Web.
- Reflect on current instruction.
- Refine existing lessons.
- Design new lessons and units.
- Share ideas and provide collegial feedback.
- Collect a portfolio of lesson ideas.
- Celebrate their successes!

Session-By-Session Synopses

Session 1

Discuss course goals.

Explore the concept of engaged learning.

Learn about the World Wide Web (WWW) as an instructional resource.

Session 2

Use the World Wide Web as a learning activity.

Session 3

Analyze video examples of instruction.

Session 4

Analyze "Print Scenarios."

Session 5

Analyze a "Sample Lesson."

Design (or refine) an instructional activity using the "Planning Framework."

Discuss the activity with a critical friend.

Session 6

Share lesson designs.

Adapt lesson ideas to other grade levels and content areas.

Create a portfolio of lesson ideas.

Reexamine individual and collective goals and discuss strategies for continued collaboration and learning.

Celebrate successes!

Although developed and refined largely by the staff at NCREL, *Learning With Technology* is designed to be delivered by local or regional technical assistance agencies and organizations experienced in providing training and professional development services to teachers, schools, and districts. NCREL provides Facilitator's Academies to prepare agency staff to deliver the course. These two-day academies (a kind of compressed *Learning With Technology* course with additional training tips and materials) equip participants with the knowledge they need to become skilled *Learning With Technology* trainers. Each Facilitator's Academy participant also receives a Facilitator's Guide and all the course materials. Academy "graduates" become certified *Learning With Technology* facilitators and are licensed through their agency to offer the course locally to teachers, schools, and districts.

NCREL has adopted this "turn-key" approach for two reasons. First, we do not believe we have adequate resources for a carrying out widespread dissemination ourselves. More important, however, both research and practical experience clearly show the need to customize professional development to local contexts. We are convinced that regional or local technical assistance agencies are in a far better position to understand local context than NCREL. Furthermore, they are in far better position to capitalize on that understanding to tailor and deliver the course in the best possible way for the end users.

Process and Impact Evaluation

The evaluation component of *Learning With Technology* is part of a larger NCREL initiative to study the science of scaling up (moving an effective educational program from a limited number of sites to a larger number while maintaining program integrity). This component is very important for providing both process and impact information about the course. The study will be conducted by the staff from NCREL's Evaluation and Policy Information Center (EPIC), who will investigate the implementation of the *Learning With Technology* course itself, the Facilitator's Academy, and the relative effectiveness of the specific turn-key strategy NCREL has designed for widespread dissemination. It will be carried out according to two phases.

In Phase One, the evaluators' major task will be to look at the Facilitator's Academy in terms of its breadth and impact. For the former, they simply will count how many staff from regional technical assistance agencies have been reached. More important, however, they also will assess how well the Academy experiences of these staff have prepared them to teach around the course. Of particular interest will be questions of facilitators' understanding of course concepts, goals, and processes and their knowledge, skill, and comfort levels as they prepare to introduce *Learning With Technology* to local schools and teachers. Finally, EPIC evaluators will analyze the relative effectiveness of different technical assistance agencies participating in the Facilitator's Academies as they deliver the course to their school and district clients.

The major task of Phase Two will be the evaluation of the course breadth, implementation, and impact. As with the Academy, the breath issue will be one simply of numbers: How many teachers or other school personnel have participated in the course? As the evaluation moves to quality of implementation, the issues will become more complex as evaluators attempt to answer questions of more central concern regarding the turn-key strategy: for example, ones related to quality, fidelity, and thoroughness of course instruction. The most dominant issue in this phase of the evaluation will be the nature and level of impact on the teachers: What do participants apply from what they learned and what are the resulting changes in the professional practice?

Methodologically, both Phase One and Phase Two of the evaluation will employ a wide range of data collection tools, including observation of activities, focus group and individual interviews, survey instruments, pre- and posttests, reaction forms, and opinionnaires. There also will be some document analyses. These various instruments will gauge changes in attitudes and impressions as well as skill and knowledge levels. Additionally, they will gauge changed or changing behavior.

Implementation Status and Early Results

As noted earlier, the *Learning With Technology* course is delivered using a turn-key approach. NCREL provides training sessions, called Facilitator's Academies, that prepare local or regional technical assistance agency staff to teach the course; they, in turn, provide the course for teachers or other local school district staff. Our evaluation design calls for us to follow, document, and evaluate both the course and the Facilitator's Academy. So far, the results from early *Learning With Technology* implementation activities are very encouraging.

To date, NCREL staff have conducted 21 Facilitator's Academies for trainers from 12 states throughout the U.S.: California, Georgia, Hawaii, Illinois, Indiana, Iowa, Michigan, North Dakota, Ohio, South Dakota, West Virginia, and Wisconsin. Nearly 400 individuals, intermediate unit staff, school district personnel, and other regional laboratory staff have been trained as facilitators for the *Learning With Technology* course.

Overall, the reactions to the Academy have been quite positive. Nearly all participants have valued the content, the processes, and the levels of interaction. For example, one facilitator commented, "My perceptions of engaged learning were reinforced. The insights and looking at the same issues from differing perspectives was enriching." Another reacted, "I found analyzing lessons most helpful. It was important to see both **use** and **misuse** of technology in units."

Likewise most participants have given high marks to the materials and resources used during the Academy and to their usefulness for helping clarify the essential course concepts of worthwhile, engaged learning and appropriate high-performance technology. One individual noted for instance, "The material was wonderful and I can [now] help teachers integrate technology in a very efficient and easy approach."

Within two months of the first Facilitator's Academy, trained facilitators began offering the course to teachers. Thus far, there have been course offerings in five states—Hawaii, Illinois, Iowa, Michigan, and Ohio—with well over 500 teachers participating. Evaluation data reveal that:

- Participants liked the way the course was designed and delivered. Nearly two-thirds (65%) of the teachers rated the amount of interaction among the participants as outstanding. Similarly, the teachers were very satisfied with the way the facilitators presented the information and the assistance they provided throughout the course.
- Working with "critical friends" is one part of the course that the teachers found to be particularly useful. One teacher remarked, "The activity with the critical friend was super. I hope my friend got as much from the activity as I did." Collaborating with other teachers in their own school and other districts was seen as a beneficial way to retrieve ideas and receive technical assistance.
- The largest impact that the course has had on teachers has been in familiarizing them with the principles of engaged learning and helping them find ways to apply these principles in their classroom instruction. Prior to the course, only about one-third of the participants rated this aspect highly. After the course, over 90 percent of the participants indicated they had good knowledge of the principles of engaged learning and use them frequently in their classrooms.
- Knowing how to develop a comprehensive planning framework that integrates technology, and using such a framework to plan units and lessons was another outcome of the course teachers saw as beneficial. Before the course, about one out of ten individuals indicated they knew how to develop such a framework and used it to plan their units and lessons. After the course, nearly seven out of ten participants indicated this to be the case.

A Look Toward the Future

The comments and reactions to our Facilitator's Academies, as well as the early results coming from teachers throughout the region who have taken the course, have been encouraging. But they also have led us to begin planning enhancements and additions to *Learning With Technology*. NCREL has launched a revision cycle for the Facilitator's Academy materials and delivery structure. The proposed revisions include reformatting the guide and adding components that provide some technical skill development and special tips for teacher training. We expect these revisions to be ready for our next round of Facilitator's Academies planned to begin in the early spring.

In addition, we are working in partnership with two regional agencies well-known for their administrator training programs— the Chicago Academy for School Leadership and Merit Network, Inc.— to design a program for educational leaders that complements the course for teachers. The objectives of this program—which has the working title *Leadership for Technology*—are to provide administrators with information and skills that will help them:

- Make better decisions about funding, selecting, and installing technology in their schools and districts.
- Design solid, workable technology plans.
- Work more productively with their teachers to integrate and support the appropriate use of technology for instruction.

David Dwyer (1996) has noted that technology most definitely can add value to schools when it is an integral part of a comprehensive plan and when those using it are prepared to use it appropriately as a tool that benefits student learning. NCREL believes that the *Learning With Technology* course and Facilitator's Academy, along with the *Leadership for Technology* program under development, will offer educators the skills and knowledge they need to use technology to add that value.

References

Ayers, W. (1993). *To teach: The journey of a teacher.* New York: Teachers College Press.

Benton Foundation. (1995). *The learning connection: Will the information highway transform schools and prepare students for the twenty-first century?* Washington, DC: Author.

Borko, H., & Putnam, R. T. (1995). Expanding a teacher's knowledge base: A cognitive psychological perspective on professional development. In T. R. Gusky & M. Huberman (Eds.), *Professional development in education: New paradigms and practices.* New York: Teachers College Press.

Bransford, J. D., Vye, N., Kinzer, C., & Risko, V. (1990). Teaching thinking and context knowledge: Toward an integrative approach. In B. F. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction.* Hillsdale, NJ: Lawrence Erlbaum.

Brooks, J., & Brooks, M. (1993). *The case for constructivist classrooms.* Alexandria, VA: Association for Supervision and Curriculum Development.

Brown, A. L. (1978). Knowing when, where, and how to remember: A problem of metacognition. In R. Glazer (Ed.), *Advances in instructional psychology* (Vol. 1, pp. 77-165). Hillsdale, NJ: Erlbaum.

Brundage, D., & Mackeracher, D. (1980). *Adult learning principles and their applications to program planning.* Ontario: Ministry of Education.

Callister, T. A., & Dunne, F. (1992). The computer as doorstop: Technology as disempowerment. *Phi Delta Kappan, 74*(4), 324-326.

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American Educator, 91*(3), 6-46.

Conte, C. (1995). *The learning connection: Will the information highway transform schools and prepare students for the twenty-first century?* [Online]. Available: http://benton.org/Library/schools/

Cuban, L. (1996). Techno-reformers and classroom teachers. *Education Week, XVI*(6), 37, 39.

Darling-Hammond, L., & McLaughlin, M. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan, 76*(8), 597-604

Dwyer, D. (1996). We're in this together. *Educational Leadership, 54*(93), 24-26.

Eraut, M. (1995). Developing professional development within a client-centered orientation. In T. R. Guskey & M. Huberman (Eds.), *Professional development in education: New paradigms and practices.* New York: Teachers College Press.

Feiman, S., & Floden, R. (1980). A consumer's guide to teacher development. *Journal of Staff Development, 1*(2), 126-147.

Gardner, H. (1991). *The unschooled mind. How children think and how schools should teach.* New York: Basic Books.

Glennan, T. K., & Melmed, A. (1996). *Fostering the use of educational technology: Elements of a national strategy.* Santa Monica, CA: Rand Corp.

Greenberg, E. J. (1995). More metro than nonmetro students have access to computers, but their rates of usage are similar. *Rural Development Perspectives, 10*(3), 61-64.

Guskey, T. R. (1997). *Results-oriented professional development: In search of an optimal mix of effective practices.* [Online]. Available: http://www.ncrel.org/sdrs/areas/rpl_esys/pdlitrev.htm

Guskey, T. R. (1997). Professional development in education: In search of the optimal mix. In T. R. Guskey & M. Huberman, (Eds.), *Professional development in education: New paradigms and practices.* New York: Teachers College Press.

Hawkes, M., Quinn, D. W., Bell, R., & Knott, T. (1996). *The Ohio School/Net Telecommunity evaluation: Year one results.* Oak Brook, IL: North Central Regional Educational Laboratory.

Heaviside, S., Farris, E., Malitz, G., & Carpenter, J. (1996). *Advanced telecommunications in U.S. public elementary and secondary schools, 1995.* Washington, DC: U.S. Department of Education.

Holly, P. (1991). Action research: The missing link in the creation of schools as centers of inquiry. In A. Liberman & L. Miller (Eds.), *Staff development for education in the 90's* (2nd ed.). New York: Teachers College Press.

Illinois State Board of Education. (1993). *The 21st century challenge: Transforming education through technology.* Springfield, IL: Author.

Jones, B. F., Valdez, G., Nowakowski, J., & Rasmussen, C. (1995). *Plugging in: Choosing and using educational technology.* Oak Brook, IL: North Central Regional Educational Laboratory; and Washington, DC: Coucil for Educational Development and Research.

Jones, B. F., Valdez, G., Nowakowski, J., & Rasmussen, C. (1994). *Designing learning and technology for educational reform.* Oak Brook, IL: North Central Regional Educational Laboratory.

Kaye, J. C., Jacobs, D. B., Aschenbacher, P., & Judd, B. (1996). *Model Nets: A national study of computer networking in K12 education.* Los Alamos, CA: Los Alamos National Laboratory.

Lieberman, A. (1995). Practices that support teacher development. *Phi Delta Kappan, 76*(8), 591-596.

Levin, J. A., & Thurston, C. (1996). Research summary: Educational electronic network. *Educational Leadership, 54*(3), 46-50.

Loucks-Horsley, S., & Stiegelbauer, S. (1991). Using knowledge of change to guide staff development. In A. Lieberman & L. Miller (Eds.), *Staff development for education in the 90s* (2nd ed.). New York: Teachers College Press.

Market Data Retrieval. (n.d.). *Upgrade your educational marketing with the most current and comprehensive technology information available today!* Shelton, CT: Author.

Market Data Retrieval. (1993). *Education and technology, 1993: A survey of the K-12 market.* Shelton, CT: Author.

McKinsey & Company. (n.d.). *Connecting K-12 schools to the information highway.* Palo Alto, CA: Author.

Moore, M. G. (1995). The death of distance. *American Journal of Distance Education, 9*(2), 18.

National Telecommunications and Information Administration. (1997). *NTIA special publication 95-33: Survey of rural information and infrastructure technologies.* Boulder, CO: Author.

North Central Regional Educational Laboratory. (1996). *GAO testimony: America's schools not designed or equipped for 21st century* (Internal Policy Summary). Oak Brook, IL: Author.

Office of Technology Assessment. (1995). *Teachers and technology: Making the connection.* Washington, DC: U.S. Government Printing Office.

Oja, S. N. (1991). Adult development: Insights on staff development. In A. Lieberman & L. Miller (Eds.), *Staff development for education in the 90s* (2nd ed.). New York: Teachers College Press.

Owston, R. D. (1997). The World Wide Web: A technology to enhance teaching and learning? *Educational Researcher, 26*(2), 27-33.

Palinscar, A. S., & Brown, A. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1,* 117-175.

Pea, R. D. (1993). Practices of distributed intelligences and designs for education. In G. Salomon (Ed.), *Distributed cognitions: Psychological considerations* (pp. 47-87). New York: Cambridge University Press.

Resnick, L., & Klopfer, R. (1989). *The thinking curriculum.* Alexandria, VA: Association for Supervision and Curriculum Development.

Roupp, R. (Ed.). (1993). *LabNet: Toward a community of practice.* Hillsdale, NJ: Erlbaum.

Roy, P. (1987, February). A consumer's guide to selecting staff development consultants. *The Developer.*

Schlosser, C., & Anderson, M. (1993). *Distance education: Review of the literature.* Ames, IA: Research Institute for Studies in Education.

Schubert, W., & Ayers, W. C. (Eds.). (1992). *Teacher lore: Learning from our own experience.* New York: Longman.

Southwest Educational Development Laboratory (n.d.). Future learning environments. *SEEDS: SEDL Rural Update,* No. 1. Austin, TX: Author.

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement (OERI)
Educational Resources Information Center (ERIC)

NOTICE

REPRODUCTION BASIS

☐ This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☑ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").